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PILOT PERSONALITY AND TRAINING OUTCOMES

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14. ABSTRACT
The current study examined the relationship between personality tests and U.S. Air Force pilot training outcomes. Two computerized tests were used, the NEO Personality Inventory-Revised and the Armstrong Laboratory Aviation Personality Survey. In addition to the traditional pass/fail training outcome, the quality of passing as well as reasons for failure were examined. Outcome criteria for training graduates included class rank, academic grades, daily flying grades, and check ride grades. Reasons for failure included flying training deficiency and being "dropped on request." Correlations in samples of between 6,200 and 12,548 trainees across the tests showed small but important relationships with training outcomes. Compared to those passing training, students who failed due to flying training deficiency were less extraverted and confident as well as more depressed and deferent. Compared to passing students, those who dropped on request were less aggressive, impulsive, and risk taking. They were also more generally neurotic, orderly, affectively labile, and anxious. Higher class rank was associated with higher levels of conscientiousness and confidence as well as lower levels of negativity, affective lability, anxiety, and depression.

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1.0   SUMMARY

The current study examined the relationship between personality tests and U.S. Air Force pilot training outcomes. Two computerized tests were used, the NEO Personality Inventory-Revised and the Armstrong Laboratory Aviation Personality Survey. In addition to the traditional pass/ fail training outcome, the quality of passing as well as reasons for failure were examined. Outcome criteria for training graduates included class rank, academic grades, daily flying grades, and check ride grades. Reasons for failure included flying training deficiency and being "dropped on request." Correlations in samples of between 6,200 and 12,548 trainees across the tests showed small but important relationships with training outcomes. Compared to those passing training, students who failed due to flying training deficiency were less extraverted and confident as well as more depressed and deferent. Compared to passing students, those who dropped on request were less aggressive, impulsive, and risk taking. They were also more generally neurotic, orderly, affectively labile, and anxious. Higher class rank was associated with higher levels of conscientiousness and confidence as well as lower levels of negativity, affective lability, anxiety, and depression.

2.0   INTRODUCTION

2.1   Pilot Personality

Sells (Ref 1), at the U.S. Air Force School of Aerospace Medicine (USAFSAM), reported one of the earliest studies of the use of personality tests for USAF flying personnel. His work showed the utility of the personality constructs of "motivation to fly" and "expression of anxieties about flying."

Looking at students in USAF pilot training, Retzlaff and Gibertini (Ref 2) used a test of normal personality, the Personality Research Form (PRF) (Ref 3), and a test of clinical psychopathology, the Millon Clinical Multiaxial Inventory (MCMI) (Ref 4), to map student pilot personality. The PRF showed the 350 student pilots to be higher than college students on scales of Affiliation, Cognitive Structure, and Dominance. They scored lower on Abasement, Autonomy, Harm Avoidance, and Understanding. The MCMI showed the student pilots to be high on Histrionic Personality Disorder and Narcissistic Personality Disorder. In general, the two tests converged on student pilots being socially outgoing, confident, organized, and risk taking.

Using the same sample to look for personality clusters, Retzlaff and Gibertini (Ref 5) found three distinct personality types among the USAF student pilots. Cluster one ("Right Stuff") students had high PRF Affiliation, Aggression, Exhibition, Impulsivity, and Play scales. They also had low scale scores on Cognitive Structure and Order.   On the MCMI, they were high on the Histrionic, Narcissistic, and Antisocial scales. The second cluster of students on the PRF had high scales on Achievement, Affiliation, Endurance, and Social Desirability. They had only a low Defendence score. On the MCMI, they had moderate Narcissistic and Histrionic scores as well as a high Compulsive Personality Disorder score. The third cluster ("Wrong Stuff") had no high scale scores on the PRF but did have low scores on Affiliation, Change, Dominance, and Exhibition. On the MCMI, they had high Compulsive scores and low Histrionic scores. Clearly, not all pilots have the same personality. Similarly, King (Ref 6) reviewed the MCMI results of 82 aviators who were clinically referred to the Aeromedical Consultation

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Service of USAFSAM and found elevations on the Histrionic and Narcissistic Personality Disorder scales, even in those aviators found by independent psychiatric examination to be free of such psychopathology.

Callister, King, Retzlaff, & Marsh (Ref 7) compared 1,301 USAF student pilots to national norms on the NEO Personality Inventory-Revised (NEO PI-R) personality test (Ref 8). They found that the student pilots were higher than the national norms, with their mean Extraversion score at the 83rd percentile of the norm, Openness at the 60th percentile, and Conscientiousness at the 58th percentile. The sample was lower than the norms on Agreeableness at only the 20th percentile and Neuroticism at the 42nd. The Extraversion and Agreeableness scores are particularly divergent from the national norms.

In a comparison of female USAF student pilots to male student pilots and to the female normative sample on the NEO PI-R, Chappelle, Novy, Sowin, and Thompson (Ref 9) found gender differences. Female pilots scored lower on Neuroticism than the female normative sample but higher on Neuroticism than the male pilots. Both male and female pilots scored substantially lower on Extraversion than the female normative sample. Female pilots scored higher on Openness to Experience than the female normative sample or the male pilots. Female pilots scored lower on Agreeableness than the female normative sample but higher on Agreeableness than male pilots. Finally, female pilots scored higher on Conscientiousness than the female normative sample but very slightly less than the male pilots.

2.2   Pilot Personality and Training

Davis (Ref 10) mailed out a package of various scales to USAF student pilots and received back 666 completed packages. He then compared the scales to passing pilot training. He found that only two of the scales consistently predicted training outcome through the various statistical procedures. He found students who passed to be more assertive ($r = 0.13$) and more extraverted ($r = 0.10$). He concluded that his predictive formulae were probably inadequate to significantly improve training selection.

Anesgart and Callister (Ref 11) examined 1,031 USAF student pilots enrolled in the Enhanced Flight Screening program. This program screened potential pilot candidates with a multi-week flight program involving high-wing, propeller-driven planes. Of the 1,031 students, 124 attrited primarily due to flying training deficiency (FlyDef) and self-initiated elimination [drop on request (DOR)]. Their paper is primarily a statistical methods piece and does not comprehensively cover all personality variables available to them, but they convincingly show the value of personality assessment in training outcome. Using logistic regression and the associated odds ratios, they show that those students high on the Neuroticism scale of the NEO PI-R are over six times as likely to self-eliminate from training as those very low on Neuroticism. The limited number of participants actually involved in that analysis is quite low, with the 31 self-eliminating students being split into several groups and compared. The work is informative, though, from both a methodological as well as content perspective.

Boyd, Patterson, and Thompson (Ref 12) also looked at the NEO PI-R but against USAF aircraft type later flown. Interestingly, this comparison may be a proxy for flight training outcomes. Usually, those highest in class rank are offered fighter aircraft and those lower are offered airlift/tanker aircraft. There are several issues that cloud this "hot hands get fighters" variable such as the number of fighter training slots available at the time, the desire of the students, and Guard/Reserve pilots flying what their squadrons fly. Moreover, some of the best

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students are given "FAIP" (first assignment instructor pilot) assignments. However, the majority of the variance is probably accounted for by class rank. Boyd et al. found that fighter pilots had lower levels of Agreeableness and higher levels of Conscientiousness than airlift/tanker pilots. While the differences were only a point or two, the fact that differences in personality are found at all is important.

The prior three papers draw attention to the types of personality variables that may play a role in pilot training success. Another question is the degree to which personality might play a role. Meta-analyses have been conducted to estimate the degree of relationship between personality and flying training criteria. Hunter and Burke (Ref 13) conducted a meta-analytic study that revealed a small correlation of 0.10 for personality as a predictor of flying training criteria. Martinussen (Ref 14) conducted a second meta-analysis and found a correlation of 0.14 with a pass/fail criterion and 0.11 with performance outcomes. More recently, and examining personality variables consistent with the NEO PI-R, Campbell, Castaneda, and Pulos (Ref 15) performed a meta-analysis on eight studies examining the effects of personality as a predictor of military pilots' outcomes in aviation training. The two USAF studies that were included in their work were the Davis (Ref 10) and Anesgart and Callister (Ref 11) works reviewed above. They found that extraversion was positively related to training outcome, with an average uncorrected correlation of 0.13. They also found that Neuroticism in general was negatively associated at -0.15 and Anxiety specifically at -0.11. Overall, the relationships between personality are small but consistent, with most findings having uncorrected correlations magnitudes in the low teens.

Finally, by way of further background, a very comprehensive review of aviation testing and selection was commissioned by the U.S. Army and accomplished by Paullin, Katz, Bruskiewicz, Houston, and Damos (Ref 16). Here, cognitive and some personality testing was reviewed with an eye toward the selection of pilot training candidates. In the past year, Howse and Damos (Ref 17) have updated that work with a very comprehensive, 275-page annotated bibliography.

2.3   USAF Personality Testing

The USAF Medical Flight Screening program screens pilot candidates prior to military pilot training. In addition to several ophthalmic and cardiac diagnostic procedures, a number of psychological tests are administered (Ref 18-20). Over the years, a number of different cognitive functioning and personality tests have been administered. The primary purpose of the tests is to archive the individual's scores for future use. The intent is to develop a registry against which future testing might be compared. A secondary purpose is clinical and operational research. Indeed, several of the papers reviewed above have used the flight screening database.

2.4   Purpose

The purpose of this study was to determine the extent to which clinical personality tests predict pilot training outcome. This work not only focused on the "passing" versus "failing" of pilot training but also on additional, more specific, variables. For those "passing," class rank, academic grades, daily flight grades, and check ride grades were used. For those "failing," the reason for "failure" was analyzed looking at FlyDef versus DOR. It was hoped that the use of two clinical tests and multiple outcome variables with large samples would help to illuminate any relationships.

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3.0   THE NEO PI-R

The NEO PI-R is a measure of the "Five Factor" or "Big Five" model of personality structure. The NEO PI-R is a test designed to measure normal personality characteristics in relatively high functioning people. It is not a test of psychopathology. It was developed as a multipurpose personality inventory and is commercially available (Ref 8).

The NEO PI-R consists of 240 statements to which the individual responds on a Likert-type scale from 1 to 5 representing "strongly disagree," "disagree," "neutral," "agree," or "strongly agree." The test is not timed and generally takes participants from 30 to 40 minutes to complete.

The test provides a number of scores. There are five "domain" level scores that include Neuroticism, Extroversion, Openness, Agreeableness, and Conscientiousness. Table 1 presents the NEO PI-R domains and their descriptions. As can be seen, a broad range of personality is assessed. There are also six "facet" scores under each domain. So, for example, under the domain (main scale) of Neuroticism, there are the subscales of Depression and Anxiety. However, only the five main domain scales are used in the current work consistent with prior work and conservative statistical philosophy.

Table 1.   Descriptions of the NEO Scales (from Ref 8)

Test	Definition
Neuroticism (N)	The tendency to experience negative emotions (anger, sadness, fear) and be emotionally unstable
Extraversion (E)	The enjoyment of social situations, excitement, and stimulation
Openness to Experience (O)	A willingness to explore new ideas and values; desire for aesthetics
Agreeableness (A)	The desire to sympathize with and help others
Conscientiousness (C)	Seeking a high level of organization and planning; the tendency to plan carefully and exercise self-discipline

Reliabilities or domain scores range from 0.86 to 0.92. The validity of the NEO-PI-R has been evaluated extensively and is summarized in the test manual (Ref 8).

3.1   Participants

Participants were 12,548 pilot training students. All were college graduates or were near completion of college. Of those reporting demographic information, 91% were male. Participants had a mean age of 23 years, and 99% were 30 years of age and under. Eighty-four percent reported that they were white. All participants were tested at either USAFSAM or the U.S. Air Force Academy.

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3.2   Procedure

The NEO PI-R was administered to the pilot training students prior to entry into Undergraduate Pilot Training (UPT). Descriptive data [means and standard deviations (SDs)] were computed for all scale scores. Univariate and multivariate statistics are presented comparing the clinical cognitive functioning test scores to outcome variables.

3.3   Outcomes

Training outcome data were from the first flying phase of USAF UPT, which involved training in either the T-37 or T-6. These outcomes do not include advanced training in the T-38 or T-1 aircraft.

Several training performance outcome criteria were used. All participants had a final training outcome of "Pass" or "Fail." However, students may fail training for several reasons. We focused with individual analyses on those who failed due to poor flying performance (FlyDef) or who self-eliminated from training (DOR). Too few participants failed for other reasons such as medical problems or "Manifestation of Apprehension" to analyze these individually.

Several additional training performance criteria were available for students who successfully completed T-37/T-6 training: class rank, academic grades, daily flight grades, and check flight grades.

Consequently, the seven variables were failure for all reasons, FlyDef, DOR, class rank, academic grades, daily flight grades, and check flight grades. Each was analyzed with *t*-tests and/or correlations as well as through multiple correlation procedures.

3.4   Results

Tables 2 through 7 contain the results for the analyses using the NEO PI-R and the criterion measures. Table 2 displays the means and SDs of the NEO PI-R for those who passed primary pilot training and those who failed for all reasons. As can be seen, those who pass training are significantly higher on Extraversion. Those who fail training are significantly higher on Neuroticism, Openness, and Agreeableness. Statistical differences were not seen on the Conscientiousness scale.

Point-biserial correlations are provided here as an effect size metric. While researchers always welcome a very large sample size, very small differences will usually be "statistically significant" yet may offer little actual practical predictive power. Indeed, that is the case here. Mean score differences between the two groups are only about one point for the four significant scales. The one point difference, in the face of the SDs of around 10, point to quite small effect sizes. The point-biserial correlations reinforce this issue with low correlations. A caveat here is that the training failures in this analysis included medical losses, so the group distinctions here are not as clear as one might like.

Mean differences between those passing training and those failing only for FlyDef reasons can be found in Table 3. Here, only the Extraversion and Openness scales show significant differences between groups, with those passing scoring higher on Extraversion and those failing for FlyDef scoring higher on Openness.

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Table 2. Means and SDs for the NEO Scales for Pass and Fail

Subtest	Pass (N=11,211)		Fail (N=1,337)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Neuroticism	46.43	9.32	47.91	9.42	5.47[a]	-.049[a]
Extraversion	57.51	9.59	56.53	10.36	-3.52[a]	.031[a]
Openness	50.49	10.16	51.52	10.19	3.52[a]	-.031[a]
Agreeableness	44.03	10.57	44.95	10.50	3.03[a]	-.027[a]
Conscientiousness	54.88	10.13	55.06	10.74	0.62	-.006

[a]$p<.01$

Table 3. Means and SDs for the NEO Scales for Pass and Failure Due to FlyDef

Subtest	Pass (N=11,211)		FlyDef (N=557)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Neuroticism	46.43	9.32	47.30	9.32	2.14	-.020
Extraversion	57.51	9.59	56.06	10.33	-3.47[a]	.032[a]
Openness	50.49	10.16	51.98	9.77	3.39[a]	-.031[a]
Agreeableness	44.03	10.57	44.70	10.42	1.47	-.014
Conscientiousness	54.88	10.13	53.89	11.11	-2.23	.021

[a]$p<.01$

Some effect specificity begins to emerge with Table 4. Here, those who DOR score higher on Neuroticism than those who pass training. Interestingly, while the correlations are still quite low, there is a two-point difference between the groups.

Table 4. Means and SDs for the NEO Scales for Pass and Failure Due to DOR

Subtest	Pass (N=11,211)		DOR (N=495)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Neuroticism	46.43	9.32	48.37	9.57	4.53[a]	-.042[a]
Extraversion	57.51	9.59	56.64	10.47	-1.97	.018
Openness	50.49	10.16	51.13	10.51	1.38	-.013
Agreeableness	44.03	10.57	44.97	11.01	1.93	-.018
Conscientiousness	54.88	10.13	56.06	10.22	2.54	-.023

[a]$p<.01$

Table 5 shows yet more NEO PI-R scale specificity. Finally, the Conscientiousness scale shows significant differences between groups. In this case, those who DOR are higher on Conscientiousness than those who fail due to FlyDef. The difference is more than two points, and the point-biserial correlation is, while still small, the highest seen yet at a magnitude of 0.10.

Table 5. Means and SDs for the NEO Scales for Failure Due to FlyDef and DOR

Subtest	FlyDef (N=557)		DOR (N=495)		Univariate Analysis	
	Mean	SD	Mean	SD	*t*-test	*r*
Neuroticism	47.30	9.32	48.37	9.57	1.84	−.057
Extraversion	56.06	10.33	56.64	10.47	0.91	−.028
Openness	51.98	9.77	51.13	10.51	−1.36	.042
Agreeableness	44.70	10.42	44.97	11.01	0.40	−.012
Conscientiousness	53.89	11.11	56.06	10.22	3.28[a]	−.101[a]

[a]$p<.01$

The univariate point-biserial correlations from the prior tables are combined in Table 6 for comparison. Additionally, an ordinary least squares multiple regression is added to show the total predictive power of all the scales combined. All five of the NEO PI-R scales were "entered" into the equation. While logistic regression would generally be the preferred method for binomial outcomes such as this, ordinary least squares is used to more easily compare across the differing variable types in subsequent analyses.

Table 6. NEO Scale Point-Biserial Correlations for Failure and Reason for Failure

Subtest	Pass/ Fail	Pass/ FlyDef	Pass/ DOR	FlyDef/ DOR
Neuroticism	−.049[a]	−.020	−.042[a]	−.057
Extraversion	.031[a]	.032[a]	.018	−.028
Openness	−.031[a]	−.031[a]	−.013	.042
Agreeableness	−.027[a]	−.014	−.018	−.012
Conscientiousness	−.006	.021	−.023	−.101[a]
Multiple *R*	.067[a]	.053[a]	.053[a]	.033[a]

[a]$p<.01$

The univariate and multivariate correlations in Table 6 are all quite small. Also, the highest correlation, modeling FlyDef versus DOR, is of limited clinical value. Interestingly, however, is how all group differences have some significant correlations. Also, it is unusual in this type of work to find different scales modeling the various group differences.

Turning to the quality of passing, Table 7 provides correlations between the NEO PI-R scores and a number of course outcomes. Class rank is largely a function of academic grades, daily grades, and check ride grades, so the reader is cautioned of the correlated nature of these outcomes. Class rank, however, is probably the best single criterion because it largely reflects the cumulative outcome of the other measures. Higher class rank is associated with higher Conscientiousness and lower Openness. Higher academic grades are seen with higher Conscientiousness and lower Extraversion. Higher daily grades go with higher Conscientiousness and lower Neuroticism, Openness, and Agreeableness. Finally, higher check ride grades are associated with lower Openness. The scale-specific correlations are again very interesting.

Table 7. NEO Scale Correlations for Training Performance

Subtest	Class Rank	Academic Grades	Daily Grades	Check Ride Grades
Neuroticism	−.024	−.022	−.031[a]	−.016
Extraversion	.016	−.067[a]	.005	.020
Openness	−.075[a]	−.022	−.079[a]	−.058[a]
Agreeableness	−.002	.005	−.039[a]	−.004
Conscientiousness	.046[a]	.064[a]	.036[a]	.012
Multiple R	.092[a]	.096[a]	.093[a]	.064[a]

[a] $p < .01$

The multiple correlations in these analyses are generally in the 0.09 level of magnitude. While still small, they are larger than the multiple Rs seen in the pass/fail analyses and are probably of some utility.

4.0 THE ARMSTRONG LABORATORY AVIATION PERSONALITY SURVEY

The Armstrong Laboratory Aviation Personality Survey (ALAPS) (Ref 21-23) was specifically developed to support the USAF pilot screening program. It sought to address a number of problems with "off-the-shelf" tests when used with pilots. It was designed to provide a single, brief test of aviation-relevant variables. Consulting practicing aviation clinicians, the research literature, and selection procedures for the USAF and National Aeronautics and Space Administration, a number of potential scales were identified. The scales were then developed through a series of rigorous psychometric steps using USAF student pilot data for item and scale development. The surviving and resulting scales were seen as suitable for "select in," "select out," and clinical evaluation purposes. In sum, the intent was to build a reliable and valid test with scales and items relevant to aviation selection and clinical assessment.

The 240 items are administered by paper-and-pencil or computer and require participants to respond "true" or "false" to each item as it applies to them. The ALAPS has 15 scales that are categorized as "Personality," "Psychopathology," or "Crew Interaction." The Personality scales include Confidence, Socialness, Aggressiveness, Orderliness, and Negativity. The Psychopathology scales include Affective Lability, Anxiety, Depression, and Alcohol Abuse. Finally, the Crew Interaction scales include Dogmatism, Deference, Team Oriented, Organization, Impulsivity, and Risk Taking. Table 8 presents the previously reported (Ref 23) descriptions for the 15 ALAPS scales.

The scales all have reliabilities of 0.70 and greater. These reliabilities were calculated using student pilots. Further, validities are high and appropriate against other scales of similar content (Ref 22).

Table 8. Descriptions of the ALAPS Scales (from Ref 21)

Scale	Definition
Personality	
Confidence	High scorers view themselves as highly capable, intelligent, and talented. This can include the negative elements of arrogance, manipulation, and condescension. Clinically, these traits may suggest narcissism.
Socialness	High scorers are extremely social and outgoing. They enjoy others and are socially comfortable. They see themselves as friendly and charming. Clinically, this may include elements of histrionic personality.
Aggressiveness	High scorers are assertive to the point of being aggressive. They take strong stands and tolerate little criticism. They are verbally and emotionally combative. This quality probably does not rise to the level of antisocial personality.
Orderliness	High scorers are orderly in a behavioral and environmental way. Their lives are structured and neat. They are methodical and disciplined. This may clinically rise to the level of compulsive personality disorder.
Negativity	High scorers are angry, negative, and cynical. They are socially punitive and not pleasant to be around. Clinically, this may rise to the level of negativistic or passive aggressive personality.
Psychopathology	
Affective Lability	High scorers are generally emotional and reactive. They can be situationally anxious, depressed, and frightened. Moods are seen as changing quickly with little provocation. Affect is volatile.
Anxiety	High scorers are chronically anxious. They worry and brood. The anxiety interferes with their lives and occupational functioning.
Depression	High scorers are depressed. Problems include dysphoric affect as well as the cognitive and vegetative symptoms of depression. They report being pessimistic, unhappy, and guilty. Extreme elevations may include clinical major depression.
Alcohol Abuse	High scorers like to drink, drink a great deal, and get intoxicated. Functioning is impaired and there may be social and occupational problems.
Crew Interaction	
Dogmatism	High scorers believe what they believe is always correct and are not open to change. They are authoritarian interpersonally. They are intolerant of other people, ideas, and actions.
Deference	High scorers are deferent to a fault. They are submissive and quiet. They concentrate on their job and are uncomfortable questioning the status quo.
Team Oriented	High scorers enjoy and believe in teamwork. They value the team effort and team rewards. They do not enjoy working alone and may be inefficient when working alone.
Organization	High scorers are systematic and organized. They coordinate and plan all elements of a project. They think things through thoroughly.
Impulsivity	High scorers act first and think second. They often act and talk without sufficient forethought. They see themselves as spontaneous. Others may be less generous in their assessment.
Risk Taking	High scorers enjoy danger and risk. New activities and situations are not frightening. They are adventurous, unafraid, and fun-loving. They are not necessarily impulsive about their activities; their actions may be calculated and include a rational appreciation of the inherent danger.

4.1 Participants

Participants were 6,200 pilot training students. As with the NEO PI-R, all were college graduates or were near completion of college. Of those reporting demographic information, 91% were male. Participants had a mean age of 23 years, and 99% were 30 years of age and under. Eighty-four percent reported that they were white. All participants were tested at either USAFSAM or the U.S. Air Force Academy.

4.2 Procedure

The ALAPS was administered to the pilot training students prior to entry into UPT. As with the NEO PI-R, comparisons were made between those passing and failing T-37/T-6 training as well as against class performance. Univariate and multivariate statistics are presented comparing test scores to training performance variables.

4.3 Results

Tables 9 through 14 contain the results for the analyses using the ALAPS and the criterion measures. Table 9 displays the means and SDs of the ALAPS for those who passed primary pilot training and those who failed for all reasons. As can be seen, those who pass training are significantly higher on Confidence, Aggressiveness, Alcohol Abuse, and Risk Taking. Those who fail for any reason are higher on Affective Lability, Depression, and Deference. The effect sizes are, as with the NEO PI-R, quite small, with mean differences rarely more than 20% of a standard deviation and correlation magnitudes at 0.06 and below.

Table 9. Means and SDs for the ALAPS Scales by Pass and Fail

Scale	Pass (N=5,480)		Fail (N=720)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Personality						
Confidence	9.74	2.92	9.29	3.16	−3.78[a]	.048[a]
Socialness	12.64	3.35	12.28	3.62	−2.64	.034[a]
Aggressiveness	9.34	2.95	8.99	3.13	−2.92[a]	.037[a]
Orderliness	12.13	3.38	12.40	3.19	2.04	−.026
Negativity	5.38	3.09	5.54	3.18	1.30	−.017
Psychopathology						
Affective Lability	4.67	3.79	5.40	3.94	4.80[a]	−.061[a]
Anxiety	2.36	3.36	2.97	3.76	4.49[a]	−.057[a]
Depression	1.56	2.22	1.89	2.35	3.69[a]	−.047[a]
Alcohol Abuse	7.88	4.02	7.09	4.01	−4.98[a]	.063[a]
Crew Interaction						
Dogmatism	5.91	2.98	5.77	2.92	−1.19	.015
Deference	6.30	2.79	6.70	2.89	3.58[a]	−.045[a]
Team Oriented	12.05	3.64	11.93	3.67	−0.82	.010
Organization	12.51	3.26	12.64	3.24	1.00	−.013
Impulsivity	7.34	3.58	7.03	3.54	−2.15	.027
Risk Taking	12.32	2.85	11.82	2.97	−4.37[a]	.055[a]

[a]*p*<.01

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Looking at only those who fail for FlyDef reasons, Table 10 show the means and univariate statistics for that analysis. Those who pass are only higher on Confidence. Those who fail for flying reasons are higher on Depression and Deference.

Table 10. Means and SDs for the ALAPS Scales for Pass and
          Failure Due to FlyDef

Scale	Pass (N=5,480)		FlyDef (N=275)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Personality						
Confidence	9.74	2.92	9.10	3.16	−3.50[a]	.046[a]
Socialness	12.64	3.35	12.13	3.56	−2.44	.032
Aggressiveness	9.34	2.95	9.07	2.95	−1.47	.019
Orderliness	12.13	3.38	12.01	3.41	−0.57	.008
Negativity	5.38	3.09	5.73	3.20	1.81	−.024
Psychopathology						
Affective Lability	4.67	3.79	5.25	3.83	2.47	−.033
Anxiety	2.36	3.36	2.84	3.65	2.30	−.030
Depression	1.56	2.22	1.98	2.25	3.04[a]	−.040[a]
Alcohol Abuse	7.88	4.02	7.55	3.74	−1.36	.018
Crew Interaction						
Dogmatism	5.91	2.98	5.85	2.99	−0.34	.005
Deference	6.30	2.79	6.84	2.85	3.11[a]	−.041[a]
Team Oriented	12.05	3.64	11.98	3.41	−0.31	.004
Organization	12.51	3.26	12.24	3.54	−1.34	.018
Impulsivity	7.34	3.58	7.37	3.52	0.15	−.002
Risk Taking	12.32	2.85	11.89	2.68	−2.41	.032

[a]$p<.01$

Table 11 shows the results for those who pass versus those who DOR. Here a different picture develops. Those who pass are higher on Aggressiveness, Alcohol Abuse, Impulsivity, and Risk Taking. Those who DOR are higher on Orderliness, Affective Lability, and Anxiety. As with the NEO PI-R, a very interesting scale specificity is seen in the different analyses.

Comparing those who fail due to FlyDef and those who DOR, Table 12 shows that only the Orderliness scale has significant mean differences. The DOR group is higher on Orderliness than the FlyDef group.

Table 13 combines the univariate point-biserial correlations from the tables above and adds a multiple correlation where all 15 of the ALAPS scales are entered into the equation. While the univariate correlations are all low, a remarkable number are significant. In addition, the differential predictive power of the various scales is encouraging. There is no single factor evident here.

The multiple correlations show the overall predictive power of the entire test. While the 0.23 for FlyDef versus DOR appears to be quite high, there is only the one significant 0.12 magnitude univariate correlation with Orderliness. The robustness of the multiple correlation is probably in question. The 0.11 multiple correlation for pass versus fail and the 0.10 for pass versus DOR are higher than those for the NEO PI-R and are potentially of use.

Table 11. Means and SDs for the ALAPS Scales for Pass and Failure Due to DOR

Scale	Pass (N=5,480)		DOR (N=305)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Personality						
Confidence	9.74	2.92	9.33	3.26	−2.32	.031
Socialness	12.64	3.35	12.32	3.81	−1.59	.021
Aggressiveness	9.34	2.95	8.85	3.33	−2.81[a]	.037[a]
Orderliness	12.13	3.38	12.79	2.86	3.34[a]	−.044[a]
Negativity	5.38	3.09	5.40	3.11	0.09	−.001
Psychopathology						
Affective Lability	4.67	3.79	5.52	4.03	3.79[a]	−.050[a]
Anxiety	2.36	3.36	3.01	3.90	3.25[a]	−.043[a]
Depression	1.56	2.22	1.78	2.38	1.65	−.022
Alcohol Abuse	7.88	4.02	6.83	4.16	−4.46[a]	.059[a]
Crew Interaction						
Dogmatism	5.91	2.98	5.69	2.82	−1.29	.017
Deference	6.30	2.79	6.64	2.95	2.06	−.027
Team Oriented	12.05	3.64	11.71	3.94	−1.58	.021
Organization	12.51	3.26	12.86	3.09	1.82	−.024
Impulsivity	7.34	3.58	6.79	3.48	−2.60[a]	.034[a]
Risk Taking	12.32	2.85	11.76	3.05	−3.31[a]	.043[a]

[a] $p<.01$

Table 12. Means and SDs for the ALAPS Scales by Failure Due to FlyDef and DOR

Scale	FlyDef (N=275)		DOR (N=305)		Univariate Analysis	
	Mean	SD	Mean	SD	t-test	r
Personality						
Confidence	9.10	3.16	9.33	3.26	0.87	−.036
Socialness	12.13	3.56	12.32	3.81	0.62	−.026
Aggressiveness	9.07	2.95	8.85	3.33	−0.85	.035
Orderliness	12.01	3.41	12.79	2.86	2.99[a]	−.124[a]
Negativity	5.73	3.20	5.40	3.11	−1.26	.052
Psychopathology						
Affective Lability	5.25	3.83	5.52	4.03	0.83	−.034
Anxiety	2.84	3.65	3.01	3.90	0.54	−.022
Depression	1.98	2.25	1.78	2.38	−1.04	.043
Alcohol Abuse	7.55	3.74	6.83	4.16	−2.18	.090
Crew Interaction						
Dogmatism	5.85	2.99	5.69	2.82	−0.67	.028
Deference	6.84	2.85	6.64	2.95	−0.82	.034
Team Oriented	11.98	3.41	11.71	3.94	−0.88	.037
Organization	12.24	3.54	12.86	3.09	2.25	.093
Impulsivity	7.37	3.52	6.79	3.48	−2.00	.083
Risk Taking	11.89	2.68	11.76	3.05	−0.56	.023

[a] $p<.01$

Table 13. ALAPS Scale Point-Biserial Correlations with Failure and Reason for Failure

Scale	Pass/ Fail	Pass/ FlyDef	Pass/ DOR	FlyDef/ DOR
Personality				
Confidence	.048[a]	.046[a]	.031	−.036
Socialness	.034[a]	.032	.021	−.026
Aggressiveness	.037[a]	.019	.037[a]	.035
Orderliness	−.026	.008	−.044[a]	−.124[a]
Negativity	−.017	−.024	−.001	.052
Psychopathology				
Affective Lability	−.061[a]	−.033	−.050[a]	−.034
Anxiety	−.057[a]	−.030	−.043[a]	−.022
Depression	−.047[a]	−.040[a]	−.022	.043
Alcohol Abuse	.063[a]	.018	.059[a]	.090
Crew Interaction				
Dogmatism	.015	.005	.017	.028
Deference	−.045[a]	−.041[a]	−.027	.034
Team Oriented	.010	.004	.021	.037
Organization	−.013	.018	−.024	.093
Impulsivity	.027	−.002	.034[a]	.083
Risk Taking	.055[a]	.032	.043[a]	.023
Multiple *R*	.111[a]	.071	.104[a]	.230[a]

[a]$p<.01$

Finally, Table 14 provides the univariate and multivariate correlations between the ALAPS scales and the performance in training of those ultimately passing pilot training. Higher class rank is associated with higher scores on Confidence and lower scores on Negativity, Affective Lability, Anxiety, and Depression. Higher academic grades are seen with higher scores on none of the scales but lower scores on Socialness, Aggressiveness, Affective Lability, Team Oriented, and Impulsivity. Daily grades are positively correlated with Confidence, Alcohol Abuse, and Risk Taking and are negatively correlated with Affective Lability, Anxiety, and Depression. Lastly, check ride grades are positively associated with Confidence and are negatively associated with Affective Lability, Anxiety, and Depression. Again as with the last table, a very interesting mix of correlations is seen with no single theme driving all training performance. Some significant correlations involve personality, some psychopathology, and some crew interaction.

The multiple correlations for the ALAPS and training performance criteria should actually be viewed as quite good given the limited expectations of this type of work. The 0.13 and 0.14 magnitude level is one of the highest found in this type of work. It is also encouraging that the multiple correlations are probably being driven by different scales for the different outcomes.

Table 14. ALAPS Scale Correlations with Training Performance

Scale	Class Rank	Academic Grades	Daily Grades	Check Ride Grades
Personality				
Confidence	.050[a]	−.009	.080[a]	.049[a]
Socialness	.015	−.051[a]	.008	.022
Aggressiveness	−.021	−.050[a]	.026	−.008
Orderliness	.028	.016	.021	.009
Negativity	−.049[a]	−.032	−.008	−.026
Psychopathology				
Affective Lability	−.074[a]	−.056[a]	−.073[a]	−.051[a]
Anxiety	−.050[a]	−.022	−.052[a]	−.041[a]
Depression	−.093[a]	−.043[a]	−.072[a]	−.067[a]
Alcohol Abuse	.035	−.002	.042[a]	.017
Crew Interaction				
Dogmatism	.011	.007	.038	.014
Deference	−.029	−.026	−.029	−.018
Team Oriented	−.035	−.063[a]	−.024	−.029
Organization	.030	.007	.022	.004
Impulsivity	−.022	−.058[a]	−.013	−.008
Risk Taking	.033	−.002	.040[a]	.026
Multiple *R*	.143[a]	.129[a]	.131[a]	.104[a]

[a] $p < .01$

5.0 DISCUSSION

Clinical personality tests appear to predict both training failure and the quality of passing. The univariate effect sizes are quite small, but the multivariate effect sizes are probably of both administrative and clinical utility. It is important to note that participants in this study completed testing well in advance of pilot training. Results, therefore, reflect prior personality organization and are not influenced by the stressors of pilot training.

Both the NEO PI-R and the ALAPS did similar jobs of predicting the outcome variables. Their scales corresponded well in prediction, giving a degree of cross-validation to the work. Both tests provided varied predictors of the outcomes, and, as such, there appeared to be good scale specificity for both tests. Neither test provided only a single factor or theme in predicting the outcome criteria. The predicting scales also appeared to be clinically relevant and reasonable.

The relationship between the test scales and training failure is highly specific to the reason for failure. Very different scales were found to predict failure due to FlyDef and failure due to DOR.

For those removed from training for FlyDef reasons, a number of NEO PI-R and ALAPS scales were predictive. The NEO PI-R pointed out that these students were less extraverted and higher on the Openness scale. On the ALAPS, failing student pilots showed lower confidence and higher depression and social deference. These findings suggest that failure due to flying problems is related to an interpersonal theme of impaired social interaction and interpersonal assertion. Undoubtedly, the main reason for flying deficiency elimination is cognitive and psychomotor. However, one wonders the degree to which interpersonal "connection" with instruction in general and the instructor pilots specifically might add to this type of failure.

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Dropping on request seems to be related to a completely different theme. On the NEO PI-R, students who DOR are seen as generally more neurotic. On the ALAPS, they are more orderly, affectively labile, and anxious. They are also less aggressive, impulsive, and risk taking. Here, a more emotional and affective picture is seen. These students, even before training actually starts, are more emotional. They lack the affective tone of the typical pilot and almost appear frightened. Clinically, one wonders if this is another form of Manifestation of Apprehension or "fear of flying," where the anxiety is not obvious to training cadre but is couched by the student as a "logical decision."

Both tests did a better job of predicting how well students who passed did in training than predicting who would fail training. Class rank was the best overall variable here, with academic grades, daily flight grades, and check ride grades adding nuance.

The NEO PI-R showed higher class rank to be associated with higher levels of conscientiousness and lower levels of openness. Please note that yet another variable is now predictive and another theme is developing. Conscientiousness includes organization, planning, and self-discipline. These variables are important in the day-to-day grind of working through the syllabus. The ALAPS shows higher class rank to be related to higher Confidence but lower Negativity, Affective Lability, Anxiety, and Depression. Here a broader mix of variables is seen, and oddly, the ALAPS Organization scale was not significant.

Academic grades show another interesting personality relationship. Here higher academic grades are associated with not only higher Conscientiousness on the NEO PI-R but lower Extraversion. This "academic loner" tone continues with the ALAPS with lower scores on Socialness, Aggressiveness, Affective Lability, Depression, Team Oriented, and Impulsivity predicting higher academic grades. There seems to be a theme of social isolation and conscientiousness in the pursuit of high academic grades. Daily flight grades and check ride grades seem to have a mix of the class rank and academic grade scales and themes.

Clinicians at UPT bases may find these data of use. Students are often referred to the flight surgeon or psychologist when failing training or seeking to self-eliminate (DOR). The themes developed above may prove useful hypotheses while discussing options with the students. For example, a student seeking to DOR may not report feelings of anxiety, but the clinician may wish to bring the topic up. Or a student may be having trouble with the academic portion of the syllabus. The clinician may explore the student's social and organizational resources.

Looking back at the literature review, poorer performers in this study appear to be similar to Retzlaff and Gibertini's (Ref 5) "Wrong Stuff" group. The lack of confidence and lack of emotional tone are evident, even when using two completely different tests.

This work is also consistent with Anesgart and Callister's (Ref 11) NEO PI-R study. They found that the Neuroticism, Extraversion, and Openness scales were associated with self-elimination from pilot training. The current study finds the Neuroticism scale associated with self-elimination here, but also Extraversion and Openness with flying deficiency failures.

Future research might focus on several things. First, from a descriptive perspective, it would be of interest to cluster these participants into three groups similar to those of Retzlaff and Gibertini. Then, determine the percentage of each of the three groups that fail due to FlyDef and DOR. The "Wrong Stuff" group should have significantly more DORs.

Second would be to look at advanced training assignment similar to the work of Boyd, Patterson, and Thompson (Ref 12) and to look at advanced training performance in the T-38 and T-1 tracks. It is possible that personality differentially drives students to fighters versus

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tankers/transports. In a way, this personality constellation would look at the "Right Stuff" personality. It is also possible that personality plays a greater role in class performance in advanced training. With much of the cognitive and psychomotor variance accounted for by passing initial flight training, differences later may be driven more by personality.

It should be noted that for several recent years, an additional personality test has been administered to student pilots in the USAF flight screening program. This test is the Personality Assessment Inventory (PAI) (Ref 24), which is more clinically oriented than the NEO PI-R or the ALAPS with scales consistent with diagnostic criteria. Too few of the students who had taken the PAI had also completed pilot training to include that test in the current study. As such, it is recommended that when sufficient participants are available, the PAI should be compared to outcome criteria such as those used here.

Finally, from a methodological perspective, the current study has taken a very conservative approach to the analyses of these data. It is common, depending upon viewpoint, to "correct" the data for various reasons. Specifically, the data could be corrected for range restriction due to prior selection of the students and unreliability of the training criteria. For analyses involving the pass/fail training scores, the correlations could also be corrected for dichotomization of the criteria.

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LIST OF ABBREVIATIONS AND ACRONYMS

ALAPS   Armstrong Laboratory Aviation Personality Survey

DOR   drop on request

FlyDef   flying deficiency failure

MCMI   Millon Clinical Multiaxial Inventory

NEO PI-R   NEO Personality Inventory-Revised

PRF   Personality Research Form

SD   standard deviation

UPT   Undergraduate Pilot Training

USAFSAM   United States Air Force School of Aerospace Medicine